

## CLAIMS

[0084] The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of trapping condensable AlCl<sub>3</sub> from a gas flow effluent from an aluminum etch reaction chamber comprising a mixture comprising AlCl<sub>3</sub> and Cl<sub>2</sub>, comprising:

directing the gas flow at a volume flow rate, a mass flow rate, and a temperature into a first stage of a trap chamber that comprises first trapping media with sufficient microsurface areas and of sufficient surface density for the volume flow rate, mass flow rate, and temperature of the gas flow to cause sufficient physical collisions of the AlCl<sub>3</sub> with the microsurface areas when temperature of the first trapping media is ambient, to cool and condense more than half of the AlCl<sub>3</sub> in the gas flow on the first trapping media;

directing the gas flow with the Cl<sub>2</sub> and any remaining AlCl<sub>3</sub> that was not condensed on the first trapping media into a second stage of the trap chamber that comprises second trapping media with a microsurface density that is greater than the microsurface density of the first trapping media and that has sufficient microsurface areas for the volume flow rate, mass flow rate, and temperature of the gas flow, to cause sufficient physical collisions of the AlCl<sub>3</sub> in the gas flow, when temperature of the second trapping media is ambient, to cool and condense the remaining 5 - 10% of the AlCl<sub>3</sub> in the gas flow on the second trapping media, leaving the gas flow after the second stage substantially free of AlCl<sub>3</sub>.

2. The method of claim 1, comprising:

directing the gas flow at a volume flow rate, a mass flow rate, and a temperature into a first stage of a trap chamber that comprises first trapping media with sufficient surface areas and of sufficient surface density for the volume flow rate, mass flow rate, and temperature of the gas flow to cause sufficient physical collisions of the  $\text{AlCl}_3$  with the surface areas when temperature of the first trapping media is ambient, to cool and condense more than half of the  $\text{AlCl}_3$  in the gas flow on the first trapping media;

directing the gas flow with the  $\text{Cl}_2$  and any remaining  $\text{AlCl}_3$  that was not condensed on the first trapping media into a second stage of the trap chamber that comprises second trapping media with a surface density that is greater than the microsurface density of the first trapping media and that has sufficient surface areas for the volume flow rate, mass flow rate, and temperature of the gas flow, to cause sufficient physical collisions of the  $\text{AlCl}_3$  in the gas flow, when temperature of the second trapping media is ambient, to cool and condense the remaining 5 - 10% of the  $\text{AlCl}_3$  in the gas flow on the second trapping media, leaving the gas flow after the second stage substantially free of  $\text{AlCl}_3$ .

3. The method of claim 1, including maintaining the gas flow from the reaction chamber to the first stage of the trap chamber at a temperature above 70 °C.

4. The method of claim 1, including directing the gas flow into the first stage of the trap at a volume flow rate in a range of 100 - 200 sccm and at a mass flow rate of 0.12 g/min. with the surface density of the first trapping media in a range of at least 2 in<sup>2</sup>/in<sup>3</sup> to less than 15 in<sup>2</sup>/in<sup>3</sup> and with the surface density of the second trapping media in a range of more than 2 in<sup>2</sup>/in<sup>3</sup> to less than 15 in<sup>2</sup>/in<sup>3</sup>.

5. The method of claim 4, wherein the surface density of the first trapping media is 8 in<sup>2</sup>/in<sup>3</sup> and the surface density of the second trapping media is 10 in<sup>2</sup>/in<sup>3</sup>.

6. The method of claim 1, including directing the gas flow via an inlet into the first stage of the trap chamber, wherein the first trapping media includes a first trapping medium positioned in the first stage of the trap chamber at an inlet-to-first medium distance from the inlet, and a second trapping medium positioned in the first stage of the trap chamber at an inlet-to-second medium distance from the inlet, and wherein the inlet-to-second medium distance is greater than the inlet-to-first medium distance, but still close enough to the inlet such that lower partial pressure of AlCl<sub>3</sub> adjacent the second medium as compared to increasing partial pressure adjacent increasing build-up of condensed, solid AlCl<sub>3</sub> on the first medium, due to lesser heat transfer efficiency of solid AlCl<sub>3</sub> as compared to the second medium, draws AlCl<sub>3</sub> preferentially toward the second medium before AlCl<sub>3</sub> build-up on the first medium occludes the inlet.

7. The method of claim 6, wherein the first medium is positioned radially outward from the inlet, and the second medium is positioned axially below the inlet.

8. A method of removing condensable aluminum chloride vapor in an effluent produced by an aluminum etching system, said method comprising:
  - flowing said effluent through a disposable element, wherein said condensable aluminum chloride vapor is cooled, condensed, and solidified as condensed aluminum chloride solid on said disposable element.
9. The method of claim 8, wherein said disposable element comprises:
  - an outer screen column;
  - an inner screen column contained within said outer screen column and in spaced relation to said outer shield such that an space is defined between said outer screen column and said inner screen column, and wherein an inner core is defined by said inner screen column;
  - a first trapping medium disposed within said inner screen column;
  - a second trapping medium disposed within said space defined by said outer screen column and said inner screen column; and
  - a third trapping medium enclosing said outer screen column.
10. The method of claim 8, wherein said disposable member is removably contained in a housing, wherein said housing encloses a chamber, said housing having an inlet opening adapted to receive said effluent into said chamber and an outlet opening.
11. The method of claim 9, wherein said trapping medium comprises a mesh.
12. The method of claim 11, wherein said mesh is metal wire.

13. The method of claim 12, wherein said metal wire is intertwined or interlaced to form a metal fabric and said mesh comprises multiple layers of said metal fabric.
14. The method of claim 12, wherein said metal wire is stainless steel.
15. The method of claim 11, wherein said mesh has a surface density (Surface Area/Unit Volume) in a range of about 2 to 15 in<sup>2</sup>/in<sup>3</sup>.
16. The method of claim 9, wherein said housing has a length and wherein said second trapping medium has a length that is about one third to one half the length of said housing.
17. The method of claim 9, wherein said inner screen column comprises a wire screen.
18. The method of claim 17, wherein said wire screen is a 4x4 to 8x8 mesh screen.
19. The method of claim 10, wherein said outer screen column is a solid metal sheet.
20. The method of claim 10, wherein said housing further comprises a guide for centering and anchoring said disposable element in said housing.
21. The method of claim 9, wherein said inner screen column is positioned over said guide.
22. The method of claim 8, wherein said disposable element is removable from said chamber and replaceable with another disposable element.
23. The method of claim 8, wherein said housing is an elongated cylinder.

24. A method of preventing build-up of solid aluminum chloride in a pump line that carries etching effluent comprising condensable aluminum chloride vapor molecules and chlorinated reaction gas molecules, said method comprising:

flowing said effluent through a disposable element, wherein said disposable element comprises trapping media for cooling, condensing, and solidifying said condensable aluminum chloride vapor molecules, wherein said trapping medium condenses and collects said condensable aluminum chloride vapor as condensed aluminum chloride solid.

25. The method of claim 24, wherein said disposable element comprises:

an outer screen column;  
an inner screen column contained within said outer shield and in spaced relation to said outer shield such that a space is defined between said outer screen column and said inner screen column, and wherein an inner core is defined by said inner screen column;  
a first trapping medium disposed within said inner screen column;  
a second trapping medium disposed within said space defined by said outer screen column and said inner screen column; and  
a third trapping medium enclosing said screen column.

26. The method of claim 24 wherein said disposable member is removably contained in a housing, wherein said housing encloses a chamber, said housing having an inlet opening adapted to receive said effluent into said chamber and an outlet opening.

27. The method of claim 25, wherein said trapping medium comprises a mesh.

28. The method of claim 27, wherein said mesh is metal wire.

29. The method of claim 28, wherein said metal wire is intertwined or interlaced to form a metal fabric and said mesh comprises multiple layers of said metal fabric.

30. The method of claim 28, wherein said metal wire is stainless steel.

31. The method of claim 27, wherein said mesh has a surface density (Surface Area/Unit Volume) in a range of about 2 to 15 in<sup>2</sup>/in<sup>3</sup>.

32. The method of claim 25, wherein said housing has a length and wherein said second trapping medium has a length that is about one third to one half the length of said housing.

33. The method of claim 25, wherein said inner screen column comprises a wire screen.

34. The method of claim 33, wherein said wire screen is a 4x4 to 8x8 mesh screen.

35. The method of claim 25, wherein said outer shield is a solid metal sheet.

36. The method of claim 26, wherein said housing further comprises a guide for centering and anchoring said disposable element in said housing.

37. The method of claim 26, wherein said inner screen column is positioned over said guide.

38. The method of claim 26, wherein said disposable element is removable from said chamber and replaceable with another disposable element.

39. The method of claim 26, wherein said housing is an elongated cylinder.